Worldwide Ocean Optics Database (WOOD)

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LONG-TERM GOAL

The long-term goal is to provide a comprehensive worldwide database containing a broad range of optical data, including the diffuse attenuation coefficient, the beam attenuation coefficient, the backscattering coefficient, and bioluminescence potential. The database must continue to be easy to use, internet accessible, and frequently updated with data from recent at-sea measurements. The database supports a wide range of applications, such as environmental assessments, sea test planning, tactical utility assessments, and Navy mission planning. Eventually it will allow for extrapolation of optical parameters in lieu of direct measurements (e.g., beam attenuation will be estimated from diffuse attenuation and backscatter data), and an error estimate will be provided for the extrapolated results.

SCIENTIFIC OBJECTIVES

Many investigations of optical characteristics require supporting data such as profiles of nutrients, temperature, salinity, and water depth. Using the WOOD, one is able to obtain combined datasets of optical properties and supporting data in order to answer questions about the controlling mechanisms for the observed optical conditions. Data from WOOD also supports the generation of regionally-specific empirical fits that capture the monthly or seasonal optical characteristics of particular locations of high naval interest. The website is equipped with data display tools (such as online maps and X-Y plots) to allow the user to quickly discern the utility of the available data to meet his or her needs.

APPROACH

Major new datasets are continually acquired from key data sources (such as NODC) and from websites for large ocean bio-optics projects (such as GLOBEC, JGOFS, etc.). Whenever possible significant historical datasets are also acquired.

In order to provide improved online graphics, we have implemented automatically downloaded JAVA applets to display data maps and profiles. Oracle Version 7.3.3 database software is used to store all metadata and optics-related data, and Oracle Webserver software Version 2.1 was selected to connect the database to the internet. The entire system is installed on a Pentium PC running under the Windows NT Server operating system. In October 1998, the database computer was upgraded to a dual processor 333 MHz Pentium using multiple hard disks to distribute the processing load. An exact duplicate system has been purchased to support development of the new capabilities (online graphics, data extrapolation, and relational searches).

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This approach allows access to the existing operational database system while simultaneously developing new displays and features the improved system.

WORK COMPLETED

Since June 1998, all of the JHU/APL paravane tow-yo cruise data (containing thousands of closely spaced profiles of beam attenuation coefficient, bioluminescence potential, optical backscatter coefficient, temperature, salinity, and chlorophyll concentration) have been processed and added to WOOD. A major new NODC dataset (extracted from the Ocean Climate Laboratory "World Ocean Database 1998" set of 5 CD-ROMs) has been processed and is nearly ready to be added to the WOOD database. (These data will more than double the amount of data in WOOD, and they include many new parameters, such as Secchi depth and concentrations of oxygen, nitrate, nitrite, phosphate, and silicate.) Also, several major datasets from websites have been processed, including the entire JGOFS Arabian Sea/Gulf of Oman dataset. As an example of the locations of newly acquired data, Figure 1 shows a map of the NODC and JGOFS data profiles.

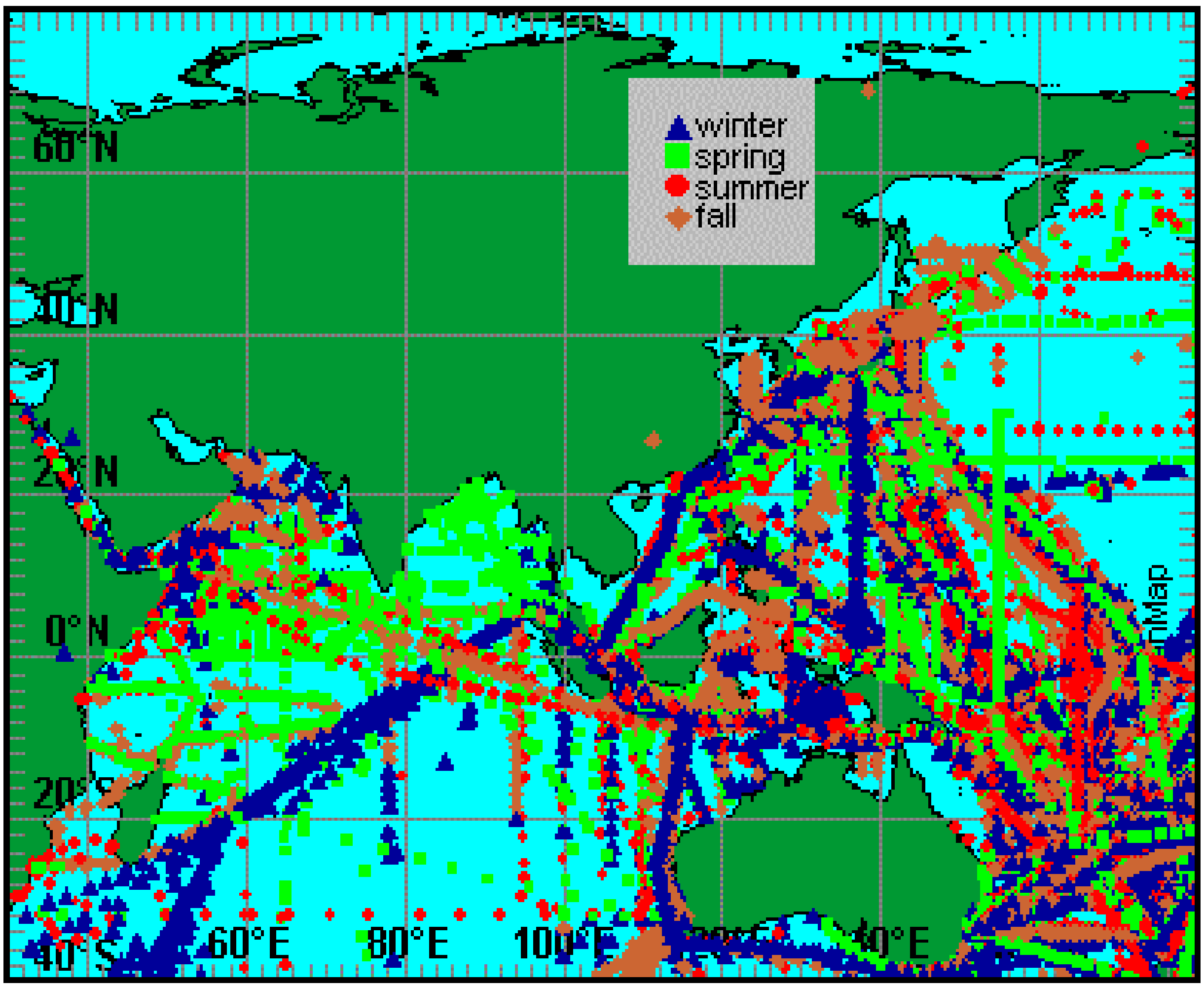

Figure 1. Example of New Data Being Added to WOOD

An online beta version of both the mapping and profile plotting software has been completed. The new graphical user interface provides great flexibility and utility to users beyond the original interface, which consisted of simply a text display of the data. The software allows the user to select a specific area of the world, time period, and depth range. Multiple data parameters for these constraints may be selected for the query. A user-definable symbol is assigned to each data parameter, and this symbol is displayed on a world map in a user-definable color representing either the season or the month that the data was collected. The world map has scrolling and zooming functionality, as well as the ability to center on a user-entered latitude and longitude. In order to see data of a specific type, the visibility of the data displayed on the map can be toggled on or off based upon season, month, or data parameter.

The data can be also displayed in text format (either in column or row format) for cut-and-pasting into any editor for saving. For a specific data parameter, the data can also be displayed on an X/Y plot. This plot may contain all data for a parameter, every N^{th} data point, or only that data which is in the current visible zoom level of the interactive world map. Colors of data on the map correspond to the colors on the X/Y plots. Data on the world map can be selected to highlight its corresponding curve on the X/Y plot. The user can also zoom in on the data in the X/Y plot and can format the color, axis, and gridlines on the graph.

As an example of these new capabilities, Figure 2 shows the “zoomed in” on-screen map of diffuse attenuation coefficient (K) and salinity (S) data found in a query for the Gulf of Oman. The color coding shows that there are no winter or spring K data in the search box, and that the summer data come from the west end of the box, leading into the Straits of Hormuz. The fall K data come from closer to the middle of the box, with only one profile near the Iranian shore.

Figure 3 shows the actual profiles from these locations, and the same seasonal color coding is used to allow the user to quickly assess seasonal effects on the profiles. The user can "click and drag" on the map to select a subset of the profile locations for subsequent plotting. The user can also use the mouse to click on a particular location, which will then be highlighted in the associated profile plot.

Another major task is to incorporate Navy needs for enhanced database capabilities in WOOD. To this end a special closed meeting has been scheduled during the Ocean Optics XIV conference to discuss the known and anticipated optics requirements of the Mine Warfare, Special Operations, and NA-ASW communities within the Navy. Preliminary materials to stimulate the discussion have been mailed to those invited to this meeting. Representatives from NAVOCEANO, NRL, NRaD, NAWC, Coastal Systems Station (Panama City), PSI, Kaman, and JHU/APL have agreed to attend this meeting, and separate meetings are being held with the Staff Oceanographers at COMSUBPAC and COMSUBLANT.

In addition to the activities described above, a written conference paper (see Reference) has been completed and will be included in the proceedings of the November Ocean Optics XIV Conference.

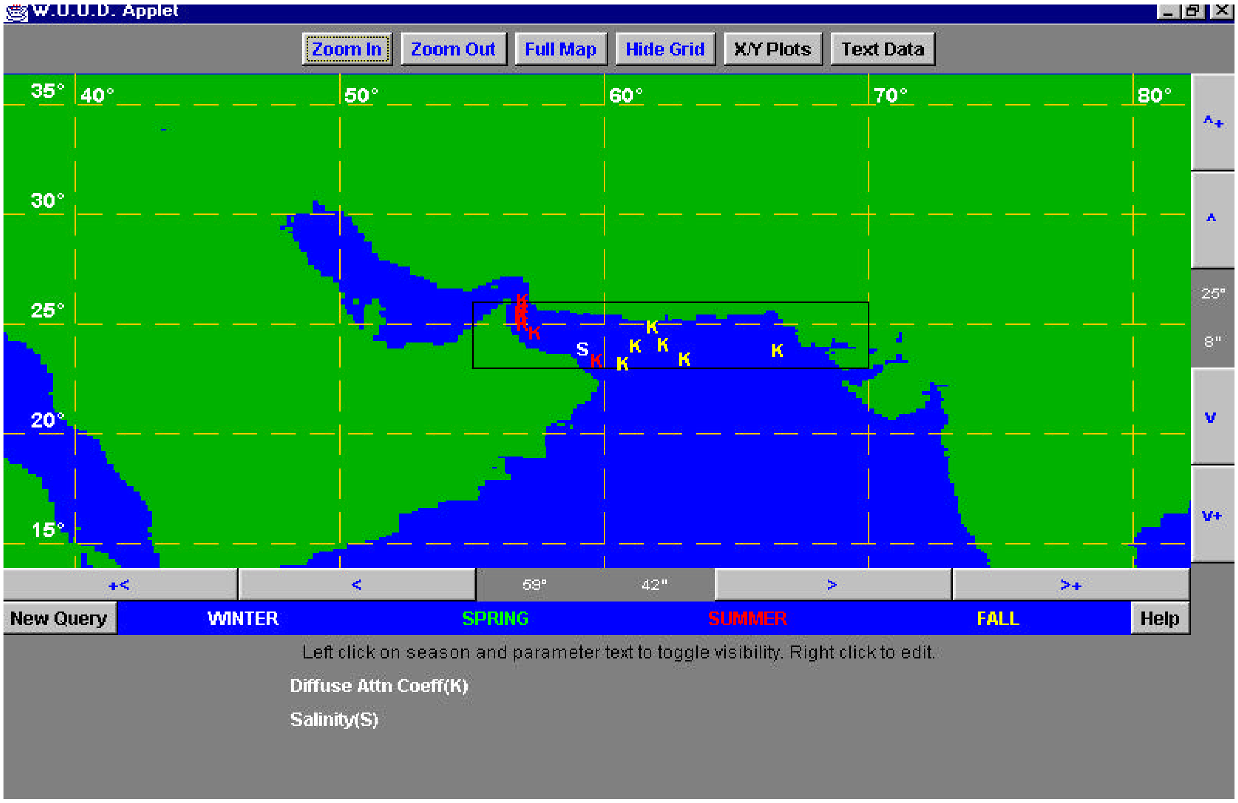

Figure 2. Example of On-line Map of Data Locations in the Gulf of Oman

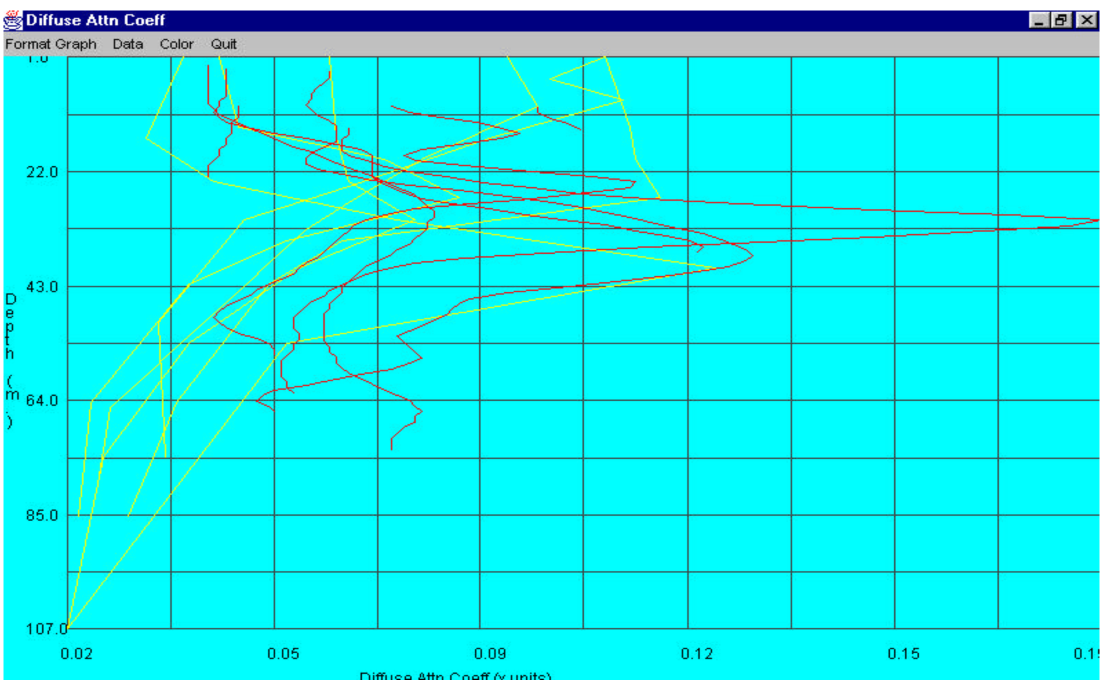

Figure 3. K profiles from Locations Shown in Figure 2. The color scheme is the same for both figures.

RESULTS

Thousands of investigators from around the world have already made use of the WOOD. For example, the database was accessed 3,397 times from January 1 through October 13, 1998. Also, about twenty scientists have asked to be included in a session on Optics Databases at the 1998 Ocean Optics XIV conference. The US Navy and DARPA have made considerable use of the database to plan upcoming optics-related field exercises, to assess the feasibility of certain optics-related detection systems, and to make vulnerability assessments for potential optics-related threats to deployed assets. Copies of all data acquired under this project are being sent to NAVOCEANO to support their internal database efforts. (Their database is not intended to be available via a public website because many of their data are DoD proprietary.)

IMPACT/APPLICATION

The availability at a single location of a uniform-format optics database has already saved the US Navy thousands of dollars in test planning operations and vulnerability assessments. This database has also been used to estimate the performance of a mine hunting system using optical detection techniques. By providing the Navy and the research community with this database, both communities benefit from improved knowledge of the optical properties of the ocean. Access to historical optics data is also useful for assessing newly acquired data. One can compare the two to see if the new results are atypical, and if so one might go on to determine the cause (e.g. unusual forcing conditions, influx of a different water mass, or perhaps even an instrument calibration problem).

TRANSITIONS

The US Navy is a major participant in the Master Environmental Library (MEL) network of computer systems which is intended to provide a vehicle to find virtually any kind of atmospheric, terrestrial, or oceanographic data. Preliminary discussions have begun to explore the idea of linking the WOOD to the MEL. Also, the WOOD system is eventually slated to be transferred to an operational organization (such as NAVOCEANO or NOAA). This subject will be discussed further in the November meeting at Ocean optics XIV.

RELATED PROJECTS

For the past two years I have managed the Environmental Assessment Project of the SSN Security Program. One task under this project has been to obtain and archive optics-related data from classified sources. These data are being stored in a format that is compatible with the WOOD design so that a classified version of the WOOD could easily be provided to the US Navy. This approach also facilitates the use of common processing and search software. I am also serving as the Environmental Specialist to the AN/BER-1 Lidar Warning Receiver (LWR) system for the NSSN. I am using the WOOD to help plan associated Navy field tests and to help build an on-board optics database that will be used to provide the NSSN with vulnerability estimates.

Finally, I have recently taken over the Environment Support System project (funded by the SSBN Security Program); this project provides over 80 databases to support Navy and DoD needs.

REFERENCES

Smart, J.H., "World-wide Ocean Optics Database," submitted to OOXIV 1998

http://wood.jhuapl.edu [WOOD website]